California Environmental Protection Agency

Air Resources Board

STAFF REPORT: INITIAL STATEMENT OF REASONS

PUBLIC HEARING TO CONSIDER THE ADOPTION OF HEAVY-DUTY VEHICLE IDLING EMISSION REDUCTION REQUIREMENTS

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EXECUTIVE SUMMARY

California's plan for reducing the reactive organic gases (ROG) and oxides of nitrogen (NOx) that contribute to both ozone and particulate matter (PM) formation, is set forth in the 2003 State and Federal Strategy for the California State Implementation Plan (2003 SIP). Mobile sources produce the majority of the state's ozone precursor emissions and diesel PM inventory. Mobile source controls are therefore important for attainment of air quality standards and constitute a significant part of the 2003 SIP. Staff's proposal reduces emissions by limiting the idle operation of on-road heavy-duty diesel engines, and is part of the 2003 SIP's proposed on-road heavy-duty vehicle control measure "ON-RD HVY DUTY 3". Staff's proposal will contribute towards the fulfillment of the committed emission reductions from this control measure.

In California, emissions generated during idle operations of heavy-duty diesel vehicles pose a significant air quality problem. Truck drivers idle their engines at truck stops and rest areas during layover hours to provide heat or cooling to the sleeper berth, to operate on-board electrical appliances, to maintain battery charge and to warm the engine for easy start-up during cold weather. Truck idling is also significant at warehouse/distribution centers and port terminals where loading and unloading freight require long waiting periods. The high density of trucks idling together at such locations for extended periods of time can produce highly localized and concentrated emissions, which affect the health of the drivers and the neighboring communities. The health concerns in particular become more serious when these idling centers are located in communities that are already disproportionately impacted by air pollution. Truck idling also consumes fuel and increases engine maintenance costs.

The proposal would require all new 2007 and later model year on-road heavy-duty diesel engines installed in vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds to be equipped with a non-adjustable idle shutdown system that automatically turns the engine off after 5 minutes of continuous operation at idle. The idle shutdown system would automatically activate when the vehicle is stopped, the transmission is set in the "neutral" or "park" position, and the parking brake is engaged. The idle shutdown system would also activate after 15 minutes of continuous idling when the vehicle is stopped, the transmission is set in neutral or park, and the parking brake is not engaged. The proposal includes a provision for resetting the idle shutdown system, which would allow the driver to continue operating the vehicle's engine at idle as long as he or she is present inside the vehicle. It also includes a provision to allow the idle shutdown system to be overridden when the engine is operating power take-off (PTO) equipment.

The proposed requirements do not apply to gasoline fueled heavy-duty engines or heavy-duty engines produced for use in buses (commercial buses as well as school buses), motorhomes, and emergency vehicles.

The proposal allows the use of alternative technologies/strategies to provide power for cab/sleeper comfort and/or other ancillaries that would otherwise have required continuous idling of the vehicle's engine. These devices include, but are not limited to, automatic stop-start systems, internal combustion engine driven auxiliary power units (APU), fuel cell APUs, and fuel-fired heaters. Such devices must meet defined performance requirements set forth in this regulation. Other technologies that do not directly produce emissions, such as power inverter chargers for use with batteries and grid supplied electricity are also allowed. Any other technology that is not identified in this proposal may be used provided it is approved by the Executive Officer.

When the proposed requirements take effect in 2007, the California trucking businesses that purchase new vehicles with sleeper berths may be required to pay more initially due to the need to buy alternative idle reduction technologies. However, these additional costs can be recovered within 1 to 3 years, depending on the amount of idle hours reduced and the type of alternative technology used, due to savings resulting from improved fuel economy and reduced maintenance requirements. In the long run, the proposed requirements will benefit the vehicle owner or operator because of reduced operating costs.

Assuming truck owners and operators use commercially available alternative technologies, staff estimates statewide emission reductions will range between 6 to 7 tons per day (tpd) of NOx, between 0.5 to 0.7 tpd of ROG, between 1 to 2 tpd of carbon monoxide (CO) emissions and between 303 to 336 tpd of carbon dioxide (CO_2) emissions in 2010, for California registered vehicles. For the South Coast Air Basin, the emission reductions range between 2 to 3 tpd of NOx, between 0.2 to 0.3 tpd of ROG, between 0.5 to 0.9 tpd of CO and between 124 to 138 tpd of CO_2 in 2010, for California registered vehicles.

Particulate emissions, depending on the alternative technology used, may be reduced by approximately 15 pounds per day (0.01 tpd) or may slightly increase (if a diesel APU is used) by as much as 34 pounds per day (0.017 tpd), statewide in 2010. Similarly for the South Coast Air Basin, PM emissions may be reduced by approximately 6 pounds per day or may slightly increase while using diesel APUs by as much as 14 pounds per day (0.007 tpd).

The fleet average cost-effectiveness of this proposal ranges between $0.25 to $0.99 per pound of NOx plus ROG reduced. This compares favorably to the cost-effectiveness of California mobile source and motor vehicle fuel regulations adopted over the past decade that range between $0.17 to $2.55 per pound of ozone precursors reduced.

I. INTRODUCTION

Over the last thirty years, California has adopted stringent emission control regulations resulting in significant emission reductions from both on-road and off-road mobile sources. While these regulations have greatly improved air quality, many regions of California continue to exceed state and federal air quality standards for ozone and fine particles. Thus, more needs to be done to improve air quality and protect the health of Californians.

California's plan for reducing the reactive organic gases (ROG) and oxides of nitrogen (NOx) emissions that contribute to both ozone and particulate matter (PM) formation, is set forth in the 2003 State and Federal Strategy for the California State Implementation Plan (2003 SIP). Mobile sources account for about 68 percent of the statewide ozone precursor inventory and about 90 percent of the statewide diesel PM inventory. Mobile source controls are therefore important for attainment of air quality standards and constitute a significant part of the 2003 SIP.

By 2010, on-road heavy-duty diesel vehicles are estimated to account for as much as 29 percent, or 537 tons per day (tpd), of the statewide mobile source NOx emission inventory and 10 percent, or 11 tpd, of the statewide mobile source PM emission inventory[1]. This is of particular concern since these estimates already take into account the stringent 2007 on-road heavy-duty diesel engine exhaust emission standards, recently adopted by the California Air Resources Board (the "Board" or the "ARB") and the United States Environmental Protection Agency (U.S. EPA). Thus, more reductions are needed from these sources. The staff's proposal is designed to further reduce emissions from 2007 and subsequent model year on-road heavy-duty diesel vehicles by reducing the time they are operated at idle.

The proposal would require all new on-road heavy duty diesel engines installed in vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds to be equipped with an idle shutdown system that automatically turns the engine off after 5 minutes of continuous engine operation at idle. The proposal also allows the use of optional engine idle reduction devices/strategies in order to provide heating and air conditioning for cab comfort, engine oil heating for easy engine start-up in cold ambient conditions, and electric power to charge batteries and for on-board accessories. Such devices include an automatic stop-start system, on-board auxiliary devices such as fuel-fired heaters and auxiliary power units (APU), and truck stop electrification equipment. The use of these devices in lieu of operating the truck engine at idle will result in significant NOx reductions. Reductions in carbon monoxide (CO), ROG, and carbon dioxide (CO_2) are also expected, but to a lesser extent depending on the type of alternative idle reduction device/strategy used. PM emissions are expected to be

[1] Based on the 2003 California Almanac Emissions Inventory Data (http://www.arb.ca.gov/emisinv/emsmain/emsmain.htm). Idle emissions from heavy-duty diesel vehicles were adjusted to reflect revised idle emission rates (Appendix C) and a revised idle time for medium heavy-duty diesel vehicles.

reduced when using the idle shutdown system and the automatic stop-start system but may remain the same or slightly increase while using diesel powered APUs.

II. BACKGROUND

This chapter provides an overview of the applicable vehicle classes included in this proposal, a brief description of the truck idling concern, associated emissions, and the 2003 SIP commitments.

A. VEHICLE CLASSES

Heavy-duty vehicles subject to the proposed regulation are those with a GVWR greater than 14,000 pounds. The majority of these heavy-duty vehicles are diesel fueled. Heavy-duty diesel vehicles greater than 14,000 pounds are further segregated into heavy heavy-duty diesel vehicles (HHDDV) and medium heavy-duty diesel vehicles (MHDDV). HHDDVs are heavy-duty diesel vehicles with a GVWR greater than 33,000 pounds and MHDDVs are vehicles with a GVWR of 14,001 to 33,000 pounds. Examples of heavy-duty vehicles included in the proposal are line-haul trucks, delivery trucks, trash trucks, bulk hauling trucks, tankers, utility trucks, and construction vehicles. The proposal does not apply to emergency vehicles, motorhomes, or buses.

B. THE TRUCK IDLING CONCERN

In California, emissions from idling heavy-duty diesel vehicles pose a significant air quality problem. Idling emissions are particularly significant at locations such as truck stops, travel centers, rest areas, and at warehouse/distribution centers and port terminals where loading and unloading freight require long waiting periods. Such locations can experience a very high density of trucks idling together for extended periods of time, thereby producing highly localized and concentrated emissions. These emissions affect the health of the drivers, truck stop, warehouse, and ports personnel, and the neighboring community. The health concerns in particular become more serious when such locations are located in communities that are already disproportionately impacted by air pollution.

C. AMOUNT OF IDLING

Heavy-duty vehicles operate a significant amount of the time at idle. Based on data collected using global positioning satellite data loggers (Battelle, 1999; JFA 2002) and information obtained from a report by the United States Department of Energy (Stodolsky et al., 2000), staff estimates that HHDDVs with sleeper berths operate at idle for 6 hours per day, HHDDVs without sleeper berths operate for 42 minutes per day, and MHDDVs operate at idle for 17 minutes per day.

The reasons for truck idling vary greatly. Truck drivers often operate their engines at idle to provide cab climate control, to power on-board appliances and/or to keep the engine oil warm to avoid cold-start problems during winter months. But according to a pilot survey on truck idling trends, conducted in Northern California, the majority of the drivers run their engines at idle mainly for heating (67 percent) and air conditioning (83 percent) purposes (Brodrick et al., 2001). These survey results suggest that if heating

and air conditioning can be maintained using an alternative idle reduction strategy, truck idling emissions in California can be reduced significantly.

D. FUEL CONSUMPTION

Besides generating undesirable emissions, engine idling also increases fuel consumption, engine wear and maintenance costs. Studies have shown that, during idling, heavy-duty diesel vehicles consume between 0.4 to 1.6 gallons per hour (gal/hr) depending on the engine size, engine speed, heating, air conditioning and electrical loads (Lambert et al., 2001; U.S. EPA, 2002). It should also be noted that during idle operation, drivers sometimes operate their engines at elevated engine speeds to provide more power to operate climate control devices and on-board accessories, to reduce cab noise and vibration, and to reduce engine wear associated with low speed idling. Tests have also shown that an increase in engine speed results in a significant increase in fuel consumption and NOx emissions (Lambert et al., 2001; U.S. EPA, 2002). Assuming an average fuel consumption of 1 gal/hr for an idling heavy-duty diesel engine, staff estimates that in 2003 the diesel fuel consumption due to idling of California registered heavy-duty diesel vehicles is approximately 272,000 gallons per day (gal/day) statewide.

E. EMISSIONS INVENTORY

Heavy-duty diesel vehicles are major contributors to California's air quality problems. On a per vehicle basis, they emit relatively high levels of NOx and PM emissions, both of which contribute to serious public health problems. As previously mentioned, it is projected that in 2010, on-road heavy-duty diesel vehicles will contribute approximately 29 percent of the statewide mobile source NOx emissions and 10 percent of the statewide mobile source PM emissions.

Based on California's emissions inventory model, EMFAC2002 ver 2.2 (ARB, 2002a), statewide NOx emissions in 2003 from extended idling of California registered heavy-duty diesel vehicles (GVWR > 14,000 pounds) are estimated to be 26 tpd[2]. This equates to approximately 5 percent of the total 2003 statewide NOx emissions from California registered heavy-duty diesel vehicles. The corresponding statewide PM emissions are estimated to be 0.8 tpd. Similarly for the South Coast Air Basin, the 2003 idling emissions from California registered idling heavy-duty diesel vehicles are approximately 10 tpd of NOx and 0.3 tpd of PM emissions.

F. EXISTING REGULATIONS

Starting in 2004, heavy-duty diesel engine standards adopted by ARB will reduce NOx emissions from these engines by 50 percent from the 1998 levels (ARB, 1998a). Starting in 2007, the ARB adopted aftertreatment forcing emissions standards that will cut both NOx and PM emissions from new engines by another 90 percent (ARB,

[2] Heavy-duty diesel vehicle idling emissions from EMFAC2002 ver2.2, were adjusted to reflect revised idle emission rates discussed in Appendix C and a revised idle time for medium heavy-duty diesel vehicles.

2001a). In addition, California also has a heavy-duty vehicle inspection program aimed at reducing emissions from the existing fleet[3].

While the ARB has successfully adopted programs to reduce emissions from heavy-duty vehicles, it has not, until recently, specifically sought to control idling emissions. In December of 2002, the ARB adopted its first anti-idling, airborne toxic control measure (ATCM) that would limit school bus idling at or near schools[4]. That ATCM requires a driver of a school bus, urban bus, or other commercial motor vehicle to manually turn off the bus or vehicle engine upon arriving at a school and to restart it no more than 30 seconds before departing.

Sections 40720 and 40720.5 of the Health and Safety Code require coastal port authorities to limit truck idling to no longer than 30 minutes. Failure to comply with this requirement subjects the port authority to a fine of $250 per vehicle per violation. The local Air Quality Control District with jurisdiction over the ports has the responsibility of enforcing this requirement.

The ARB has also initiated voluntary incentive and demonstration programs to reduce idling. For example, the Carl Moyer Program[5] promotes the introduction of APUs as an idle reduction device for heavy-duty vehicles by providing monetary incentives that pay for the installation costs of APUs.

G. STATE IMPLEMENTATION PLAN (SIP)

Although many of the measures in the 1994 ozone SIP have been adopted, federal air quality standards will not be attained in many areas of the state by the statutory deadlines. As a result, the ARB updated the 1994 SIP and generated a revised 2003 SIP. The 2003 SIP includes new measures to further reduce emissions and move towards achieving the federal air quality standards for ozone and PM. One on-road heavy-duty vehicle measure contained in the 2003 SIP is measure "On-RD HVY-DUTY-3." This measure consists of several control measures such as PM In-Use Emission Control, Engine Software Upgrade, On-Board Diagnostics, Manufacturers' In-Use Compliance, and Reduced Idling. It commits, at a minimum, to achieve between 1.4 and 4.5 tpd of ROG reductions and between 8 and 11 tpd of NOx reductions in the South Coast Air Basin in 2010. This proposal is part of measure ON-RD HVY-DUTY-3 and will contribute towards fulfillment of the committed emission reductions.

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[3] California currently has two heavy-duty vehicle inspection programs, the Heavy-Duty Vehicle Inspection Program (HDVIP) and the Periodic Smoke Inspection Program (PSIP). Under the HDVIP, heavy-duty diesel trucks and buses are tested for excessive smoke emissions and inspected for tampering at random roadside locations, weigh stations and fleet facilities. The PSIP compliments the HDVIP by requiring California-based truck and bus fleets with two or more heavy-duty diesel vehicles to annually test their own vehicles to measure smoke opacity and to check for tampering. Title 13, California Code of Regulations sections 2180 et seq. and 2190 et seq., respectively.

[4] Title 13, California Code of Regulations, section 2480.

[5] An ARB program, implemented in 2000, that provides incentive money to help promote the introduction of emission reducing technologies into California.

III. NEED FOR CONTROL

As previously mentioned, on-road heavy-duty diesel vehicles contribute significantly to the statewide NOx and PM emissions inventory. NOx is one of the two primary contributors to the formation of ozone and contributes to serious health issues to citizens exposed (ARB, 2001a). Diesel PM has been identified by the ARB as a toxic air contaminant based on its potential to cause cancer (ARB, 1998b), but can also result in other serious health problems such as asthma and reduced lung function (ARB, 2001b).

Besides producing excess ROG, NOx, CO and PM, unnecessary engine idling also produces undesirable CO_2 emissions. CO_2 is one of the major greenhouse gas emissions responsible for global warming (ARB, 2002b).

The staff's proposal would significantly reduce NOx emissions and associated health risks by reducing the time heavy-duty diesel vehicles are operated at idle. The benefits from this proposal are particularly significant in communities located close to truck stops, travel centers, rest areas, ports, warehouse/distribution centers, and other locations where extended truck idling activity occurs. The proposal will also help reduce CO_2 emissions and the state's dependence on foreign oil (via reduced fuel consumption). It will benefit trucking businesses by saving money through improved fuel economy and reduced maintenance requirements.

IV. SUMMARY OF PROPOSED REQUIREMENTS

Staff recommends the Board amend Section 1956.8 Title 13, California Code of Regulations and the incorporated "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", as set forth in Appendices 1 and 2.

A. APPLICABILITY

The requirements in this proposal apply to all new diesel-fueled on-road heavy-duty engines and vehicles with a GVWR greater than 14,000 pounds, certified for sale in California in 2007 and subsequent model years.

The proposed requirements do not apply to gasoline-fueled heavy-duty engines or heavy-duty engines produced for use in buses (commercial buses as well as school buses), motorhomes, and emergency vehicles. Gasoline fueled heavy-duty vehicles are excluded because the hot and cold start emissions associated with gasoline engines could cancel out or even exceed the benefits from reduced idling. Commercial buses and school buses carry passengers and have large volumes and window areas that necessitate a system with high heating and/or cooling capacity. Therefore, these classes of vehicles are excluded from the proposed requirement. The majority of motorhomes sold in California are gasoline-fueled and are equipped with generators[6]. Their contribution to idling emissions is negligible so they are also excluded from the proposed requirements.

B. PROPOSED REQUIREMENTS

1. Idle Shutdown System

The proposal requires engine manufacturers to install, on specified new 2007 and subsequent model year diesel-fueled on-road heavy-duty engines, an idle shutdown system that automatically turns the engine off after 5 minutes of continuous idle operation. The system must be tamper resistant and non-adjustable. The 5 minute idle time limit will not interfere with conducting any certification or in-use testing of the engine.

Conditions for Shutdown

The idle shutdown system must automatically activate when the vehicle comes to a stop, the transmission is set in the "neutral" or "park" position, and the parking brake is engaged. After activation, the system will shut down the engine after 5 minutes of continuous engine operation at idle. The requirement that the parking brake be engaged as a condition for the system's activation eliminates the

[6] According the Recreational vehicle Industry Association, approximately 95 percent of the motorhomes sold in California in 2002 are equipped with generators (RVIA, 2003). Based on EMFAC2002 ver2.2, 93 percent of these vehicles are gasoline-fueled (ARB, 2002a).

possibility of undesirable engine shutdown, such as when the vehicle is stopped in traffic idling for more than 5 minutes. However, there is a concern that drivers may use this feature to override the idle shutdown system. A driver could park a vehicle without engaging the parking brake and have the engine run at idle indefinitely. To prevent this, the proposal would also require that if the parking brake is not engaged but the vehicle is stopped and the transmission is in neutral or in park, the idle shutdown system would be activated and shut down the engine after 15 minutes of continuous idling.

Engine Shutdown Delay

The proposal includes a provision that would allow the operator to reset the idle shutdown system before engine shutdown. A warning signal, such as a light or sound indicator inside the vehicle cabin, may be used to alert the operator 30 seconds prior to engine shutdown. The idle shutdown system may be reset by momentarily changing the position of the accelerator, clutch, or brake pedal or any other mechanism only during the last 30 seconds of the 5-minute shutdown time limit (or the last 30 seconds of the 15 minutes when the parking brake is not engaged). This will allow vehicle operators to continue operating the engine at idle as long as they are present inside the vehicle.

Power Take-Off Devices

The proposal allows the idle shutdown system to be overridden when the engine is operating power take-off (PTO) equipment. The PTO unit uses the vehicle's engine to transfer power to auxiliary equipment. So, if the vehicle is doing "work" while it is idling, the idle shutdown system would not be activated. Examples are trash trucks, cement mixers, mobile cranes, dump trucks, and vehicles with conveyors or other loading or unloading devices.

Enforcement Mechanism

To discourage tampering and detect malfunctions of the idle shutdown system, ARB staff, at a later date, will propose to the Board On-Board Diagnostic (OBD) system requirements for heavy-duty vehicles that will include monitoring of all emission control systems, including the vehicle's idle shutdown system. It is expected that these OBD requirements will be proposed to the Board in 2004 and will be implemented on 2007 or later model-year vehicles. The OBD proposal will require the vehicle's OBD system to monitor the function of the idle shutdown system when the conditions for idle shutdown are met. The OBD system will log fault codes if the system is tampered with or if it malfunctions. The fault codes can then be downloaded from the OBD system and inspected by ARB field inspectors in current or future heavy-duty vehicle roadside inspection programs.

Furthermore, because engine manufacturers must include a statement in their applications for certification that their heavy-duty diesel engines will comply with the idle shutdown system requirement, any violation of this requirement is enforceable through applicable sections of the Health and Safety Code.

2. Alternative Idle Reduction Devices

When the proposed requirements take effect in 2007, it is expected that operators of on-road heavy-duty vehicles, in particular those with sleeper berths, will need some type of an alternative idle reduction device, in conjunction with an idle shutdown system, that provides power for cab heating and cooling, engine heating, and electrical power to charge batteries and operate on-board accessories. Currently, commercially available idle reduction devices capable of providing some or all of these necessities include automatic stop-start systems, auxiliary devices such as fuel-fired heaters, and APUs. Automatic stop-start systems come in two options, an "engine only" option, which monitors the battery charge level and the engine oil temperature, and a "cab comfort" option which includes monitoring of "engine only" parameters as well as sleeper berth temperature. The proposal allows the use of these and other alternative idle reduction technologies. The technologies identified by this proposal for use as alternatives to truck idling must meet the following requirements:

Automatic Stop-Start System

- Availability of the cab/sleeper climate control (or "cab comfort") mode will be limited to vehicles with sleeper berths. Both vehicles with or without sleeper berths may be equipped with the engine temperature and battery voltage control (or "engine only") mode.
- For vehicles equipped with the cab comfort mode, the engine may continuously run at idle during the initial start-up of the system to meet the sleeper berth thermostat setting or run at idle for a maximum of 1800 seconds, whichever occurs first (or "initial idling event"). Thereafter, the system shall cycle the engine off and on, as needed to provide cabin air temperature control. However, during any consecutive 1800-second time period following the "initial idling event," the engine must not idle more than a total of 900 seconds during ambient temperatures between 25°F and 95°F. The sensor for measuring the ambient temperature must be located where it is minimally impacted from heat sources such as from solar radiation, the vehicle's engine, the engine's exhaust pipe and any other heat source on-board the vehicle.
- For maintaining engine oil temperature, the system may start the engine only when the oil temperature drops to 60°F or less and would stop the engine when the engine oil temperature reaches 80°F or less.
- For maintaining battery voltage, the system would start the engine when the battery voltage drops below its design limits and would run until the battery reaches its normal state of charge. To prevent tampering with the battery charge control, the system must shut down the engine within 1800

seconds of idling operation and may automatically restart the engine, if needed for battery charging, 30 seconds after engine shutdown.

Auxiliary Power Unit

- Internal combustion engines used in APUs must comply with the applicable California emission standards and test procedures for their fuel type and horsepower category. In addition, because PM emissions from Tier 2 certified diesel APU engines [7] are expected to exceed idle PM emissions from the 2007 model year particulate trap equipped on-road heavy-duty diesel engines[8], APU's must either be equipped with a verified Level 3 particulate trap, as defined in title 13, CCR §§ 2700 to 2710, or must have their exhaust emissions controlled by the heavy-duty diesel vehicle's PM trap/filter.

Fueled-Fired Heaters

- Fueled-fired heaters must comply with the applicable California emissions standards and test procedures as specified in the Low Emissions Vehicle program (LEV II) requirements, section 1961(a)(15), title 13, CCR, or in Part I.E.1.13 of the "California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles" (adopted August 5, 1999, amended December 12, 2002). However, unlike the LEV II program requirement that limits the operation of fuel-fired heaters to ambient temperatures of 40ºF or less, the proposed regulation allows the operation of fuel-fired heaters at any ambient temperature.

Other Idle Reduction Devices

- In addition to the above mentioned technologies, the following devices may also be used to provide any of the necessities (e.g., heating, cooling and electrical power) that would otherwise require the engine to idle:
  - fuel cell auxiliary power unit
  - power inverter/chargers for use with batteries and/or grid supplied electricity
- Any other technology not identified in this proposal may be used with prior approval of the Executive Officer.

[7] Tier 2 standards of the off-road diesel engine standards will take effect in 2005. The emission standards for engines with horsepower ratings between 0 to 11 hp (0 to 8 kW) are 5.6 g/bhp-hr (7.5 g/kW-hr) of NMHC+NOx, 6.0 g/bhp-hr (8.0 g/kW-hr) of CO, and 0.6 g/bhp-hr (0.8 g/kW-hr) of PM.

[8] Starting with model year 2007, on-road heavy-duty diesel engines are required to comply with PM exhaust emission standards of 0.01 gram per brake-horsepower-hour.

V. TECHNOLOGICAL FEASIBILITY

A significant amount of idling of heavy-duty diesel vehicles can be reduced by using currently available idle control technologies. Some of these technologies can also provide sleeper/cab heating and cooling, heat for engine warming, and electrical power for battery charging and on-board accessories. Each technology has its advantages and drawbacks. These technologies include electronically controlled idle limiters, on-board auxiliary devices and grid-supplied electrical power.

A. ELECTRONIC IDLE LIMITERS

Idle limiting devices are software based idle limit controls. They include idle shutdown timers and automatic stop-start systems.

1. Idle Shutdown System

Idle shutdown systems are standard features in most modern electronically controlled on-road heavy-duty engines. The system is built into the engine's electronic control software and enables the engine to shutdown automatically if it is left to idle more than the programmed time. For example, the system can be programmed to shutdown automatically between 2 to 100 minutes in engines made by Detroit Diesel Corporation (DDC), between 2 to 1440 minutes in engines made by Cummins Inc., and 3 to 60 minutes in engines made by Caterpillar Inc. The system can also electronically turn off the ignition key to avoid battery discharge that may occur if accessories, such as lights and/or the radio, were left in the "on" position during engine shutdown. However, although shutdown systems are available as standard features in modern electronically controlled engines, in most cases fleet owners and operators do not activate or program these systems to limit idling. Therefore, with a minor modification in the programming of the electronic control software, the key requirement in the staff's proposal can already be met with currently available idle shutdown systems.

2. Automatic Stop-Start System

Automatic stop-start systems are predominantly comprised of additional engine software controls that automatically stop and restart the engine as necessary to maintain the engine and cab/sleeper berth temperatures, and battery voltage within pre-set limits. Several manufacturers, including DDC, Cummins Inc., Caterpillar Inc. and Mack Trucks Inc. currently offer this feature as a factory option. To date, DDC alone has over 75,000 of these systems installed on its engines nationwide. For safety purposes the system only works when the parking brake is engaged with the transmission in neutral, the hood engine/compartment closed, and the ignition key in the "on" position. The system is disabled by turning off the ignition or if the vehicle is driven. Customers can choose between two options, either an "engine only" mode or a "cab comfort" mode. The "engine only" mode monitors engine oil temperature and battery voltage, while the "cab comfort" mode includes monitoring of engine mode parameters as well as sleeper berth temperature. In the cab comfort mode, a

thermostat located inside the sleeper berth monitors the inside temperature and sends a signal to the electronic control module (or in some cases a separate control module) when to stop and restart the engine to maintain the sleeper berth temperature in the desired range. The system includes a sensor for monitoring the outside ambient temperature so that under extreme ambient conditions the engine runs continuously.

The amount of idle reduced by the automatic stop-start system varies from truck to truck for many reasons. Among the major factors influencing the amount of engine run time are the ambient temperature and humidity, drivers preferences of temperature settings, power needs to operate on-board accessories, efficiencies of air conditioning systems, and insulating capabilities of the floor and the sleeper walls. Taking all these factors into consideration, industry sources indicate that automatic stop-start systems reduce idle time, on average by approximately 50 percent (Schneider, 2002; Diefenbaker, 2003). The system does not add weight to the truck and does not require separate maintenance.

A frequently cited drawback of this system is the discomfort it causes to the sleeping driver during the periodic stop and restart of the engine. However, to minimize driver discomfort, the technology has been developed such that the engine speed slowly increases during start-up and slowly decreases before shutdown. Also, this technology still requires the inefficient use of the vehicle engine to meet ancillary needs. Depending on truck manufacturer, the system retails between $800 to $1,200. The aftermarket version retails around $2,000 installed (Diefenbaker, 2003, Schneider, 2002).

B. AUXILIARY DEVICES

Auxiliary devices are truck mounted and can be used to provide some or all of the necessities that would normally require the truck engine to idle. These devices include fuel-fired heaters and APUs.

1. Fuel-Fired Heaters

Fuel-fired heaters are used to provide heat to the cab/sleeper berth and/or to preheat the engine block for easy engine start-up during cold weather. Different models exist for a variety of applications such as pick-up trucks, buses, and marine vessels. They run 20 or more hours on a gallon of diesel fuel and typically use the fuel from the truck's fuel tank. They are relatively small, inexpensive and consume much less fuel than an idling diesel engine. A report by the U.S. EPA shows that diesel fuel-fired heaters reduce NOx emissions by approximately 99 percent and fuel consumption by 50 to 80 percent (U.S. EPA, 2002). The drawbacks of this technology are its inability to provide cooling and its use of the truck's battery power for operation. Cost of fuel-fired heaters range between $1,000 to $3,000 per unit (U.S. EPA, 2003).

2. Auxiliary Power Units

APUs use a small internal combustion engine equipped with a generator/alternator to provide climate control, heat to the engine for cold weather starting, 12-volt DC electrical power to charge the batteries and 110-volt AC power for on-board accessories. The APU typically uses fuel from the vehicle's fuel system. The fuel consumption of diesel fueled APUs range between 0.08 to 0.3 gal/hr (Stodolsky et al., 2000). This is a significant fuel savings compared to the vehicle's engine idling fuel consumption rate of about a gallon or more per hour. NOx emission reductions are also significant ranging between 89 to 94 percent less compared to when the vehicle's engine is idling and the air conditioning system is engaged (U.S. EPA, 2002). The drawbacks are their initial cost, additional weight, and maintenance requirements. The cost for an APU ranges between $5,000 to $7,000 (U.S. EPA, 2003).

3. Fuel cell APU

An auxiliary power source that has a promising future in eliminating truck idling emissions is the fuel cell APU. A fuel cell produces electricity by converting the chemical energy of fuel directly to electrical power in a controlled chemical reaction. Fuel cells are clean and efficient. They can provide sufficient power to heat or cool a cab/sleeper compartment and run on-board electrical equipment. However, technical and economic issues, such as availability and infrastructure of a suitable fuel, the production costs of the units, and integration of the units with other on-board truck systems need to be overcome before these systems can become cost-effective for commercial truck operators.

C. ON-SHORE ELECTRICAL POWER

1. Truck Stop Electrification

The development of an electrical power infrastructure at truck stops is another option to reduce engine idling emissions. This technology provides trucks with 110-volt AC electrical power at truck stops to run the air conditioning, heating and on-board appliances. This requires truck stops to be equipped with electrical outlets throughout the parking spaces and trucks would need to be equipped or retrofitted with inverter/chargers, electrical power connections and an electrically driven air conditioning unit. The inverter/chargers are used to charge the truck batteries from grid supplied electricity and to convert the truck batteries' 12-volt DC to 120-volt AC power for all on-board appliances. Currently, Freightliner, Volvo and International offer AC power inverters that are built into the truck as a factory option. The drawbacks of this system include the high initial truck stop infrastructure cost, cost for equipment add-ons to trucks, and its availability, which is limited to truck stops only. The cost for inverter/chargers is approximately $1,400 per truck and an AC operated air conditioning unit is approximately $1,350 per unit. A truck stop electrification infrastructure

installation cost is approximately $2,500 per truck parking space (Stodolsky et al., 2000).

2. Truck Comfort Services

An alternative to truck stop electrification, that does not need truck modifications has been recently introduced by IdleAire Technologies. This system provides 110-volt AC electrical power for on-board appliances, an externally mounted, individual thermostatically-controlled, heating and air conditioning unit and hook-ups for basic telephone, internet and television (access to cable/satellite) services at each truck parking space. The unit is connected to the truck through a console mounted to the truck window using a template insert. The console contains all the necessary connections and controls, including a card reader for the billing system. Currently, the basic services cost about $1.25 to $1.50 per hour. The drawbacks are the infrastructure installation and maintenance costs and its availability limited to truck stops only. The infrastructure cost is approximately $10,000 per parking space and may vary depending on the number of parking spaces installed.

VI. REGULATORY ALTERNATIVES

The staff evaluated various alternatives to the proposed requirements. A description of the alternatives and the rationale for rejecting them are as follows:

A. DO NOT REQUIRE IDLE LIMITING DEVICES

This alternative would continue to allow heavy-duty vehicle owners and operators to *voluntarily* use idle reduction technologies through educational and incentive programs and not require idle shutdown systems on new heavy-duty vehicles. However, voluntary incentive programs developed by the ARB to reduce emissions from idling heavy-duty vehicles have not proven to be effective. For example, the ARB's Carl Moyer Program provides incentives to reduce emissions from truck idling by encouraging the purchase and installation of alternative idle reduction technologies. It offers funds to cover APU installation costs of up to $1,600 per diesel APU installation and up to $3,100 per alternative fuel, electric motor or fuel cell APU installation. To date, staff is not aware of any applications for funding of this project. Although the cost of currently available idle reduction technologies can be recovered within 3 years from fuel savings and reduced maintenance requirements, trucking businesses have not been motivated to use these technologies. Hence, the emission reductions expected from voluntary programs that target truck idling have not been realized. Therefore, staff believes that reducing truck idling only through voluntary measures may not be effective enough to achieve our emission reduction goals.

B. REQUIRE IDLE SHUTDOWN SYSTEMS AND ONLY ZERO-EMITTING ALTERNATIVE IDLE REDUCTION TECHNOLOGIES

Under this alternative, 2007 and subsequent model year heavy-duty vehicles would be required to be equipped with idle shutdown systems that would shut down the engine after 5 minutes of idle time. However, unlike the proposed requirement, it would only allow the use of zero emitting alternative idle reduction devices such as fuel cell APUs or truck stop electrification. In other words, it would not allow the use of on-board idle reduction devices such as automatic stop-start systems, diesel or gasoline powered APUs, fuel-fired heaters or any other on-board device that has associated emissions during its operation. Staff did not pursue this alternative, as truck stop electrification is not available everywhere and fuel cell APUs are still in the development stage and may not be economically and technologically feasible in the 2007 timeframe.

VII. ECONOMIC IMPACTS

A. LEGAL REQUIREMENTS

Government Code Sections 11346.3 and 11346.5(a) require state agencies adopting or amending any administrative regulations identify and assess the potential for adverse economic impacts on California businesses and individuals. The assessment must include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation of business, and the ability of California businesses to compete with those of other states.

In addition, state agencies are required to estimate the cost or savings to any state or local agency, and school districts. The estimate is to include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

B. AFFECTED BUSINESSES

Businesses that may be affected as a result of the proposed regulation include heavy-duty engine and vehicle manufacturers, manufacturers of idle reduction devices and California trucking businesses. Based on California engine certification data, the ARB has identified 21 heavy-duty engine manufacturers worldwide that manufacture and certify their engines for sale in California. There are also approximately 8 or more heavy-duty vehicle manufacturers that manufacture and sell their heavy-duty vehicles in California. However, none of the heavy-duty engine or vehicle manufacturing businesses is located in California and none of them is considered a small business. The number of manufacturers of idle reduction devices is not known, however the majority of them are located outside of California.

The number of California trucking businesses affected by the regulation was estimated from CHP's Biennial Inspection of Terminals [9] Program database. According to this database, approximately 98 percent of the trucking businesses, which account for 52 percent of the truck population, belong to fleet sizes of 24 vehicles or less. Assuming the fleet size of a small business to consist of 24 vehicles or less, approximately 98 percent of the trucking businesses are in the small business category.

C. POTENTIAL COSTS TO ENGINE MANUFACTURERS

The proposal would require engine manufacturers to install non-adjustable and tamper-proof idle shutdown systems on heavy-duty engines. An idle shutdown system is a standard feature on current electronically controlled on-road heavy-duty engines but they are not programmed to shut the engine down after 5 minutes. Setting the idle time is left to the vehicle owner and the system can easily be overridden to allow the engine

[9] California Vehicle Code Section 34501.12 requires any person or organization directing the operation of trucks or trailers to participate in an inspection program conducted by the CHP to inspect California truck terminals every two years.

the engine to idle continuously. Therefore, staff expects engine manufacturers to comply with the requirement through a minor change in the programming of the electronic engine software. As a result, staff expects that engine manufacturers will not incur any significant additional cost related to the technology to comply with the proposed requirement.

However, since the proposed regulation is a California only requirement, it is projected to have a minimal cost impact on engine manufacturers. This cost is due to additional administrative costs related to the need to separately manufacture and track those engines destined for sale in California from those for sale in the 49-states. Staff assumes this incremental cost to be negligible and absorbable within the purchase price of the engine.

D. POTENTIAL COSTS TO VEHICLE MANUFACTURERS

The proposed regulation is not expected to result in any significant increase in costs to heavy-duty vehicle manufacturers. Engine shutdown software is already present and integrated with the vehicle. However, the proposed optional requirement that sleeper trucks with automatic stop-start systems achieve a 50 percent reduction in idle time during ambient temperature conditions of 25°F and 95°F may necessitate improvements in the air conditioning capacity and the insulation of the sleeper berth. This may result in an increase in the cost of a truck with a sleeper berth and equipped with an automatic stop-start system. Also, since the proposed regulation is a California only requirement, there may be some administrative costs in assuring that the vehicles meet the proposed requirements. Vehicle manufacturers currently offer optional automatic stop-start systems at a cost ranging between $800 to $1,200. Staff expects these costs to decrease with an increase in demand when the proposed regulations take effect. Assuming a cost of $1,200 per unit and a $300 incremental cost for improvements in the air conditioning system, cab insulation, and administrative costs, staff estimates that the total cost of the automatic stop-start system meeting the proposed requirements will not exceed $1,500 per unit.

E. POTENTIAL IMPACT ON TRUCKING BUSINESSES

When the proposed requirements take effect in 2007, staff expects that trucking businesses, in particular those that purchase new trucks with sleeper berths, will purchase trucks equipped with alternative devices to run heating and air conditioning systems and to power on-board accessories during layover hours. This may result in additional costs to trucking businesses when they initially purchase new trucks. However, depending on the amount of idling hours reduced and the type of alternative idle reduction device used, these additional costs can be recovered within 1 to 3 years through improved fuel economy and reduced maintenance requirements. In the long run, the proposed requirements will benefit the vehicle owner or operator because they will realize a net savings from improved operating costs. An example of how these savings will be achieved is shown below, in Table 1.

Table 1 shows the savings realized and the payback periods for a diesel-fueled APU and the automatic stop-start system. The savings were estimated assuming the vehicle idles, on average, 6 hrs/day, consumes an average of one gal/hr of diesel fuel during idling, and the cost of diesel fuel is $1.63 per gallon[10]. Total savings from preventative maintenance and engine overhaul requirements were assumed at $0.14 per hour (Stodolsky et al., 2000).

Table 1: Fuel and Maintenance Savings

	Fuel and Maintenance Savings ($/year)	Cost per Unit	Payback Period
Diesel-fueled APU	$ 2,916	$ 7,000	~ 2.4 years
Automatic Stop-Start System	$ 1,758	$1,500	~ 10 months

F. POTENTIAL IMPACT ON BUSINESS COMPETITIVENESS

The proposed regulation is not expected to adversely impact the ability of California businesses to compete with businesses in other states. As previously discussed, although businesses purchasing trucks with sleeper berths will most likely require vehicles equipped with an alternative idle reduction device, resulting in higher initial purchase costs, those businesses will also realize net savings in operating costs for those vehicles. Staff's proposal is expected to, over the useful life of the vehicle, improve California trucking business' competitiveness by significantly reducing operating costs.

G. POTENTIAL IMPACT ON JOBS AND BUSINESS CREATION, ELIMINATION, OR EXPANSION

The proposed regulation is not expected to have a significant effect on the creation, elimination and expansion of jobs and businesses in California. However, the regulation may result in an increase in demand for alternative idle reduction technologies and this in turn, may result in the creation or expansion of some businesses. The increased demand for alternative idle reduction technologies may also result in the creation of new jobs related to research and development of advanced alternative idle reduction technologies, and jobs related to the manufacturing, distribution and marketing of these technologies. Most of the businesses and jobs created are expected to be located near

[10] The diesel fuel cost of $1.63 per gallon is obtained by averaging the weekly California diesel fuel prices for the 52 weeks between 11/4/2002 to 10/27/2003. Historic weekly retail on-highway diesel prices are available from the U.S. DOE, Energy Information Administration at http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp.

the engine and/or vehicle manufacturing facilities out of the state but some may be created in California.

H. POTENTIAL COSTS TO LOCAL AND STATE AGENCIES

There are no additional net costs for local and state agencies associated with adopting the proposed regulation. Typically, local government and state agencies purchase vehicles without sleeper berths, so those vehicles only require minimal modifications to the engine's software, resulting in minimal cost to the purchaser. It is expected that agencies purchasing compliant vehicles would realize net operating savings. Other costs, such as implementation costs to the state as a result of this rulemaking, would be costs directed to the ARB to implement and enforce the requirements, which should be negligible and absorbable within the existing ARB programs and budget.

VIII. ENVIRONMENTAL JUSTICE

The ARB is committed to integrating environmental justice in all of its activities. State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. On December 31, 2001, the Board approved “Policies and Actions for Environmental Justice”, which formally established a framework for incorporating environmental justice into the ARB's programs consistent with the directives of state law. The policies developed apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low income and minority communities.

These Policies are intended to promote the fair treatment of all Californians and cover the full spectrum of ARB activities. Underlying these Policies is a recognition that the ARB needs to engage community members in a meaningful way as it carries out its activities. People should have the best possible information about the air they breathe and what is being done to reduce unhealthful air pollution in their communities. The ARB recognizes its obligation to work closely with all stakeholders--communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement these Policies (ARB, 2001c).

The proposed idle reduction requirements, would benefit the people of California by reducing their exposure to harmful pollutants and diesel toxics. In particular, the proposed requirements will provide significant air quality benefits to communities located in proximity to truck stops, ports, distribution centers, and other truck idling centers where a high density of trucks idle together for extended periods of time. Furthermore, most of these locations are in areas that are already affected by the cumulative impact of air pollution from multiple mobile, commercial, industrial, areawide, and other sources. The adoption of this regulation, therefore, affirms the Board’s commitment to the fair treatment of all people throughout California.

IX. ENVIRONMENTAL IMPACTS AND COST EFFECTIVENESS

This chapter presents the air quality benefits and cost-effectiveness resulting from the implementation of the proposed idle reduction requirements.

A. AIR QUALITY BENEFITS

The proposed regulations achieve emission reductions by reducing engine idling of on-road heavy-duty diesel vehicles through existing cost-effective technologies. For various reasons, it is difficult to precisely estimate the emission benefits from the proposed regulations because staff can not accurately predict at this time the type and distribution of alternative technologies used to comply with the proposed regulation.

Another major uncertainty is the idle emission rate estimates associated with aftertreatment-based NOx and PM control technologies to be used with the 2007 and later model year heavy-duty diesel vehicles. Staff is not aware of any data that describes the performance of filter-based technologies or NOx catalysts during extended diesel idling operation. However, based on knowledge of how these technologies work, the following conclusions can be made:

1. PM filters by nature of their construction are expected to trap PM at the same efficiency during idling as when the vehicle is operating under other typical driving conditions. Thus, the 2007 and later model year PM idling emission rates should be adjusted to reflect the PM filter efficiencies.

2. NOx catalysts require a minimum temperature (light-off) for a catalytic reaction to occur. The light-off temperature for NOx catalysts is generally above 150°C (Kubsh, 2002), while exhaust temperatures during extended idling are typically below 110°C. Therefore, it can be concluded that engine-out NOx and ROG emissions will remain unaffected by the catalysts at the low exhaust temperatures that exist during engine idling. However, the U.S. EPA, in its laboratory testing to demonstrate the technical feasibility of the 2007 heavy-duty engine standards, observed NOx emission control for more than 10 minutes of idle operation following loaded (or high temperature) conditions due to the thermal inertia of the NOx catalyst (U.S. EPA, 2000). However, the size of the NOx catalyst system relative to the engine size tested was significantly larger than what is currently being developed for real-world heavy-duty vehicle applications. A smaller catalyst system would have less thermal inertia resulting in less NOx control for a period of time much shorter than the 10 minutes of NOx control observed in the U.S. EPA testing. Thus, due to the lack of data on currently developed NOx catalysts, staff assumes that NOx control resulting from the thermal inertia mass of the NOx catalysts will be less than 5 minutes of idle time, allowed by the proposed regulation. Thus, NOx emission reduction estimates from the proposed requirements will remain unaffected, as the first 5 minutes of idling have not been included in the estimation of the emission benefits.

However, since NOx emissions at idle will be controlled by the NOx catalysts for the first few minutes following engine operation under load, staff adjusted the idle emission baseline estimates to reflect this technology.

Idle emission rates incorporated in California's emissions inventory model, EMFAC2002 ver 2.2 (ARB 2002a), are based on test data from a limited number of vehicles. In addition, the emission test data were obtained at "curb" idle speeds and did not include accessory loading. However, studies have shown that idling emissions are greatly dependent on ambient conditions, accessory loading, and engine speed (Lambert et al., 2001; Storey et al., 2003). As a result, staff modified the EMFAC2002 idle emission factors using emissions test data obtained from phase 1 of the Coordinating Research Council (CRC) project E-55/E-59 (Gautam et al., 2003) and emissions test data from a multi-agency study which included the U.S. EPA and Oak Ridge National Laboratory (ORNL) (Storey et al., 2003). The idle emission rates used in quantifying the air quality benefits from the proposed regulation are shown in Table 2. (Refer to Appendix C for a detailed discussion on the methodology used to develop the idle emission factors).

Table 2: Extended Idle Emission Rates

2007 and Later Model Year Heavy-Duty Diesel Vehicles (g/hr)

NOx	PM	HC	CO	CO2
109	0.15	8	41	5846

Staff has attempted to estimate a range of the potential emission reductions that could be achieved assuming two scenarios. Both scenarios assume that HHDDVs without sleeper berths and MHDDVs would only be equipped with idle shutdown systems. The actual emissions reductions would lie between these two values.

Scenario 1 assumes that all 2007 and later model year on-road heavy-duty diesel vehicles with sleeper berths[11] would use an automatic stop-start system. This would reduce idling on average by 50 percent, which equates to a 50 percent reduction in idle emissions of all pollutants.

Scenario 2 assumes all 2007 and later model year on-road heavy-duty diesel vehicles with sleeper berths would use diesel APUs. The APU would reduce the idle operation of the vehicle by almost 100 percent. However, the emissions reduced would not be equal to 100 percent since they would be off-set by emissions from the diesel APU.

[11] Based on confidential information from several heavy-duty vehicle manufacturers, approximately 20 percent of HHDDVs sold in California are equipped with sleeper berths.

In estimating emission benefits from diesel APUs, staff assumed that diesel APUs would be certified to Tier 2 off-road diesel engine emissions standards shown in Table 3. Additionally, these APUs are assumed to be equipped with a verified Level 3 PM trap/control strategy, which will reduce PM emissions by 85 percent from the certification level of 0.6 g/bhp-hr. Furthermore, it is assumed that the diesel APU will be capable of providing the daily horsepower load needed by the idling heavy-duty vehicle which is estimated to be in the range of 4 to 6 kW (Brodrick et al., 2001). Staff has assumed a 5 kW (6.7 hp) power need in the calculations.

Table 3: Off-Road Diesel Emission Standards (g/bhp-hr)[12]

Model Year	NOx+NMHC	CO	PM
2005 and later	5.6	6.0	0.6

Based on the above assumptions, Tables 4 and 5 show the 2010 and 2020 baseline emissions and the emission reductions associated with the two scenarios statewide and for the South Coast Air Basin, respectively. The baseline emissions include idling emissions from all heavy-duty diesel vehicles while emission reductions include reductions from using idle shutdown systems on all 2007and later model year MHDDVs and HHDDVs and an automatic stop-start system and APU on 2007 and later model year HHDDVs with sleeper berths.

As shown in Tables 4 and 5, using diesel APUs as an alternative to truck idling may result in a very small increase in PM emissions. However, the proposed U.S. EPA Tier 4 emissions standards for off-road engines will cut PM emissions by 50 percent starting with the 2008 model year and will significantly reduce the PM emissions increase shown in Tables 4 and 5.

[12] In estimating the emissions benefits from APUs, staff used the certification standards for NOx, HC, PM and CO as their emission rates. However, since there are no CO2 standards for engines, to estimate the CO2 benefits from diesel APUs, staff used an average emission factor of 2203 g/hr estimated from data published by U. S. EPA (EPA420-R-02-025).

Table 4: Statewide Idling Emission Reductions
(tons per day)

Pollutant	Baseline Idling Emissions	Emission Reductions	
		Automatic Stop-Start System	Diesel APU
2010			
NOx	35	6	7
PM	0.6	0.008	(0.017)
ROG	5	0.5	0.7
CO	16	2.1	1.2
CO2	2066	303	336
2020			
NOx	43	21	24
PM	0.3	0.027	(0.063)
ROG	4	1.9	2.4
CO	17	7.6	4.3
CO2	2440	1102	1225

Table 5: South Coast Air Basin Idling Emission Reductions
(tons per day)

Pollutant	Baseline Idling Emissions	Emission Reductions	
		Automatic Stop-Start System	Diesel APU
2010			
NOx	14	2	3
PM	0.2	0.003	(0.007)
ROG	2	0.2	0.3
CO	6	0.9	0.5
CO2	792	124	138
2020			
NOx	17	8	10
PM	0.1	0.011	(0.026)
ROG	2	0.8	1.0
CO	11	3.1	1.7
CO2	950	443	493

B. COST-EFFECTIVENESS

The costs of complying with the proposed requirements include costs associated with idle shutdown systems and costs associated with alternative technologies to replace truck idling. As mentioned previously, idle shutdown systems are currently standard features on most electronically controlled on-road heavy-duty vehicles, and staff therefore expects engine manufacturers to meet this requirement with a minor modification in the programming of the electronic control module. However, manufacturers may incur minimal costs related to administrative costs due to the need to keep track of engines destined for California. Staff assumes this incremental cost to be negligible and absorbable within the purchase price of the engine.

When the proposed requirements take effect, trucks with sleeper berths have the option of using an alternative technology to replace truck idling. It is difficult at this time to assess what the distribution of the various technologies will be when the proposed regulation is implemented. Staff has therefore estimated cost-effectiveness for two technologies, the automatic stop-start system and a diesel APU, assuming a useful life of 10 years for each technology. As shown in Table 6, the cost effectiveness of the proposed idle reduction requirements is $0.53 per pound of NOx plus ROG for HHDDVs with sleeper berths using an automatic stop-start system and $1.83 per pound of NOx plus ROG for HHDDVs with sleeper berths using an APU. The fleet average cost-effectiveness, including MHHDDVs and HHDDVs with and without sleeper berths, is $0.25 per pound of NOx plus ROG reduced if an automatic stop-start system is used and $ $0.99 per pound of NOx plus ROG reduced when an APU is used.

Table 6: Cost Effectiveness in Dollars per Pound of NOx+ROG Reduced

Vehicle Class	MHDDV	Non-Sleeper HHDDV	Sleeper HHDDV	
Technology	Idle Shutdown System		Idle Shutdown System and Automatic Stop-Start System	Idle Shutdown System and Diesel APU
Cost of Technology	---	---	$1,500	$7,000
Emissions Reductions NOx+ROG (pounds)	188	574	2811	3815
Cost-Effectiveness $/pounds	0.05	0.02	0.53	1.83

Fleet Average Cost-Effectiveness ($/pounds)	
0.25 if automatic stop-start system is used	0.99 if diesel APU is used

X. CONCLUSIONS AND RECOMMENDATION

The proposed idle reduction requirements are necessary to ensure further emission reductions needed to meet clean air goals as specified in the 2003 SIP. The proposed requirements can be met using existing, commercially available technologies. The use of these technologies would significantly reduce the idling time of heavy-duty engines and result in a substantial reduction in emissions of NOx. The emission reductions are cost-effective and favorably compare to other mobile source and fuels regulations adopted by the Board. The proposed regulation is not only cost-effective in reducing air pollution, but also helps businesses become more competitive via improved vehicle operating costs. In addition to reducing greenhouse gas emissions, it will also help reduce the state's dependency on foreign oil and is also consistent with the Board's policy regarding Environmental Justice. The staff therefore recommends that the Board adopt the proposed idle reduction requirements for on-road heavy-duty diesel engines/vehicles.

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